



Evaluating the Applicability of Data-Driven Dietary Patterns to Independent Samples with a Focus on Measurement Tools for Pattern Similarity



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ARTICLE INFORMATION

Article history:

Submitted 14 December 2015

Accepted 11 May 2016

Available online 28 June 2016

Keywords:

Dietary patterns
Pattern similarity
Congruence coefficient
Breast cancer
Mediterranean/Western patterns

Supplementary materials:

Table 1, Figure 1, and Figure 4 available online at www.andjnl.org

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<http://dx.doi.org/10.1016/j.jand.2016.05.008>

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ABSTRACT

Background Diet is a key modifiable risk for many chronic diseases, but it remains unclear whether dietary patterns from one study sample are generalizable to other independent populations.

Objective The primary objective of this study was to assess whether data-driven dietary patterns from one study sample are applicable to other populations. The secondary objective was to assess the validity of two criteria of pattern similarity.

Methods Six dietary patterns—Western (n=3), Mediterranean, Prudent, and Healthy—from three published studies on breast cancer were reconstructed in a case-control study of 973 breast cancer patients and 973 controls. Three more internal patterns (Western, Prudent, and Mediterranean) were derived from this case-control study's own data.

Statistical analysis Applicability was assessed by comparing the six reconstructed patterns with the three internal dietary patterns, using the congruence coefficient (CC) between pattern loadings. In cases where any pair met either of two commonly used criteria for declaring patterns similar (CC ≥ 0.85 or a statistically significant [$P < 0.05$] Pearson correlation), then the true similarity of those two dietary patterns was double-checked by comparing their associations to risk for breast cancer, to assess whether those two criteria of similarity are actually reliable.

Results Five of the six reconstructed dietary patterns showed high congruence (CC > 0.9) to their corresponding dietary pattern derived from the case-control study's data. Similar associations with risk for breast cancer were found in all pairs of dietary patterns that had high CC but not in all pairs of dietary patterns with statistically significant correlations.

Conclusions Similar dietary patterns can be found in independent samples. The P value of a correlation coefficient is less reliable than the CC as a criterion for declaring two dietary patterns similar. This study shows that diet scores based on a particular study are generalizable to other populations.

J Acad Nutr Diet. 2016;116:1914-1924.

DIET IS A KEY MODIFIABLE RISK FACTOR FOR MANY chronic diseases.¹⁻³ For many years, nutritional epidemiology has focused on individual dietary factors in relation to disease. However, dietary pattern analysis has emerged as an important area of research. The study of dietary patterns may better capture dietary variability in the population than tracking individual foods or nutrients, while also accounting for interactions between dietary factors.⁴⁻⁶ Many investigator-driven indexes evaluate dietary quality against predefined criteria.^{7,8} Reproducibility and consistency of the associations between

the adherence to such indexes and disease have been widely explored.^{1-3,8,9} Nevertheless, investigator-driven dietary patterns are applicable only in populations that consume the foods described in the index and its construction is mainly based on the existing evidence of the association between diet and cardiovascular disease, making them less than ideal to explore associations with other diseases.⁴⁻⁶

Dietary patterns that are more representative of a specific population can be identified with data-driven methods like principal component analysis (PCA), factor analysis (FA), and cluster analysis (*a posteriori* methods).¹⁰ Data-driven dietary

patterns also present the advantage of being extracted independently of disease associations, which allows evaluation of the role of actual eating habits in disease risk. However, one of the main criticisms of these methods is that the patterns extracted are dependent on the population and, therefore, difficult to apply to other settings.^{6,11,12} Conversely, some authors have proposed methods to construct simplified measures of dietary patterns that may facilitate their replication in different populations.¹³ To our knowledge, no studies have explored the applicability of data-driven dietary patterns using the simplified measures to date.

Despite the fact that various authors have proposed methods to evaluate the congruence between components or factors extracted with PCA or FA,¹⁴⁻¹⁶ such congruence is usually assessed with simple linear correlations between adherence scores, basing the conclusion about pattern similarity only on the significance of such correlations.¹⁷⁻²⁰

The objective of this study was to assess whether data-driven dietary patterns extracted in different populations are applicable to a sample of participants with similar characteristics, comparing different measurements of similarity of patterns and their associations with breast cancer risk. This was achieved by reconstructing dietary patterns from other populations and comparing their characteristics and associations with breast cancer against similarly labeled dietary patterns that were internally derived with PCA in a case-control study of breast cancer.

MATERIALS AND METHODS

EpiGEICAM Study Population

Data used were from the EpiGEICAM study, whose design description has been provided previously.²¹ Briefly, EpiGEICAM is a Spanish case-control study that recruited, between 2006 and 2011, 1,017 incident cases of female breast cancer diagnosed in the oncology departments of 23 hospitals affiliated with the Spanish Breast Cancer Group. Each case was matched with a healthy control of similar age (± 5 years), selected from case patients' in-laws, friends, neighbors, or work colleagues residing in the same town. Cases and controls completed a structured questionnaire on demographic and anthropometric characteristics, personal, family, gynecologic, obstetric, and occupational history, as well as past physical activity and diet. Dietary intake during the past 5 years was estimated using a 117-item semi-quantitative food frequency questionnaire²² adapted to and validated in different Spanish adult populations.^{23,24} Postmenopausal status was defined as absence of menstruation during the past 12 months.

The EpiGEICAM study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the ethics committees of the 23 participating hospitals. Written informed consent was obtained from all subjects.

Dietary Patterns in EpiGEICAM

Three dietary patterns that characterize the diet of the Spanish women have been recently identified in the control group of the EpiGEICAM study²¹ using PCA. The first pattern was labeled Western and characterized by high intake of high-fat dairy products, processed meat, refined grains, sweets, caloric drinks, convenience food and sauces, and by

low intake of low-fat dairy products and whole grains; high adherence to this pattern was associated with an increased risk of breast cancer. The second was labeled Prudent, characterized by high intake of low-fat dairy products, fruits, vegetables, whole grains, and juices; this pattern was not associated with breast cancer. The third pattern was labeled Mediterranean because it was characterized by high intake of fish, vegetables, legumes, boiled potatoes, fruits, olives, and vegetable oil, and by low intake of juices. A strong adherence to this pattern was associated with lower breast cancer risk.

Dietary Patterns in Independent Populations

To assess the applicability of data-driven dietary patterns developed in different populations with similar characteristics, a bibliographic search of the scientific literature published between 2000 and 2014 and reporting on the association between dietary patterns and breast cancer risk was carried out. The search was performed in PubMed using the following key words: *Breast Neoplasms* (Medical Subject Headings term), *diet patterns*, *dietary patterns*, and *food patterns*. In addition, all references included in three recent reviews²⁵⁻²⁷ were screened. Eligibility criteria were that the study population consisted of white adult women, dietary patterns were derived with PCA or FA, the study reported pattern loadings ≥ 0.15 for food groups, and dietary intake was classified in food groups that allowed the replication of dietary patterns in EpiGEICAM data.

Of the 44 identified articles, three were eligible for inclusion. Six dietary patterns from these studies were selected: the Western and Mediterranean dietary patterns from Bessaoud and colleagues (France),²⁸ the Western and Prudent patterns from Adebamowo and colleagues (United States),²⁹ and the Western and Healthy patterns in Terry and colleagues (Sweden).³⁰ The following patterns were compared:

1. Castelló and colleagues'²¹ Western with Bessaoud and colleagues',²⁸ Adebamowo and colleagues',²⁹ and Terry and colleagues'³⁰ Western.
2. Castelló and colleagues'²¹ Prudent with Bessaoud and colleagues',²⁸ Mediterranean, and Adebamowo and colleagues',²⁹ Prudent and Terry and colleagues'³⁰ Healthy.
3. Castelló and colleagues'²¹ Mediterranean with Bessaoud and colleagues',²⁸ Mediterranean, and Adebamowo and colleagues',²⁹ Prudent and Terry and colleagues'³⁰ Healthy.

Given that the differences between dietary habits identified under the names of "Mediterranean," "Prudent," or "Healthy" are often subtle, both Castelló and colleagues'²¹ Prudent and Mediterranean, were compared with Bessaoud and colleagues'²⁸ Mediterranean, Adebamowo and colleagues'²⁹ Prudent and Terry and colleagues'³⁰ Healthy. A description of these studies is provided in Table 1 (available online at www.andjrn.org).

Applicability

The PCA reports, for a given pattern, a set of weights associated with each food group (commonly called component/pattern weights) that is used to calculate pattern scores, defined, for each individual, as a weighted sum of the food group consumption. Pattern scores measure the extent of

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